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Curbing the Use of Ultrasonography in the Diagnosis of Acute Kidney Injury:

Penny Wise or Pound Foolish?

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Acute kidney injury is a common complication in hospitalized patients, occurring in approximately 10% of hospitalizations,^{1,2} and the incidence of AKI appears to be on the rise.^{3,4} Although the most common cause of hospital-acquired AKI is acute tubular necrosis,⁵ physicians frequently rule out urinary tract obstruction as the underlying cause of AKI using ultrasonography. While renal ultrasonography is a safe and noninvasive test, it is not without cost. Moreover, since obstruction is a relatively uncommon cause of hospital-acquired AKI, the majority of ultrasonography results obtained are negative. Therefore, it is likely that in at least a subset of patients with AKI, ultrasonography has limited utility and may not be cost-effective.

Licurse et al attempt to refine our diagnostic algorithm in AKI by developing a scoring system to identify patients at high and low risk of AKI due to urinary tract obstruction.⁶ The study population comprised all hospitalized patients with suspected AKI who underwent renal ultrasonography at Yale–New Haven Hospital between January 2005 and May 2009. Suspected AKI was based on the indication for ultrasonography. For inclusion into this study, patients were subsequently confirmed to have AKI, defined as a rise in serum creatinine concentration of at least 0.3 mg/dL.

To identify clinical risk factors for hydronephrosis, a derivation sample of 100 patients with hydronephrosis diagnosed with ultrasonography and 100 randomly selected controls was used; results were subsequently validated using 797 ultrasonography studies obtained over 16 months.

The authors considered 36 variables for inclusion in their risk stratification model, including factors predisposing to obstruction or to other common specific causes of AKI, such as prerenal azotemia. The primary study outcomes were hydronephrosis and hydronephrosis requiring an intervention (urologic stent and/or nephrostomy tube). The authors also considered the incremental benefit of identifying incidental findings by ultrasonography.

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The authors identified multiple risk factors for hydronephrosis on univariate analysis; reassuringly, these factors included the following: history of hydronephrosis, history of abdominal or pelvic cancer, prior pelvic surgery, or a single functioning kidney. Patients with a history of heart failure, granular casts on urinalysis, elevated leukocyte count, documented hypotension, or exposure to aspirin, diuretics, or vancomycin during hospitalization were less likely to have hydronephrosis. The authors' final predictive model included 7 variables. In the derivation sample, the model had an area under the receiver operating characteristic curve of 0.79; in the validation sample, the corresponding value was 0.80, indicating satisfactory but not excellent discrimination.

The authors proceeded to create a risk score for use in clinical practice. They assigned point scores to identified risk factors and stratified patients into low-, medium-, and high-risk groups; all patients with a history of hydronephrosis were considered high risk. In the validation sample, the overall prevalence of hydronephrosis was 10.6%. According to the authors' clinical decision rule, 27.8% of patients were assigned to the low-risk group; this group had a prevalence of hydronephrosis of 3.1%, and only 1 patient required intervention. The prevalence of hydronephrosis was 10.7% and 16.1% in the intermediate- and high-risk groups, respectively. With this model, the number needed to screen to find 1 case of hydronephrosis in the low-risk group was 32, and for 1 case of hydronephrosis requiring an intervention, 223.

What then are the implications of this stratification scheme for clinical practice? The study suggests that a low-risk population can be identified based on demographic and clinical risk factors, and that in this population, the prevalence of hydronephrosis, and in particular hydronephrosis requiring an intervention, is quite low. However, the majority of patients who underwent ultrasonography did not fall into the low-risk category; nearly 3 of 4 patients were considered intermediate or high risk. The authors report a sizable potential cost savings by avoiding ultrasonography in low-risk patients, which they estimate at approximately \$42 000 per year at their own institution, assuming a cost of \$200 per test.

There are some limitations to this study that should be considered. First, only patients with AKI who underwent ultrasonography were considered in this analysis. Since all patients with AKI were not studied, the true incidence of AKI associated with urinary tract obstruction cannot be accurately assessed. While it is possible that even lower-risk groups might be identified if all patients with AKI had been studied, differential test ordering could have introduced important biases. For example, if AKI were less well recognized in elderly patients owing to more modest elevations in serum creatinine concentration, prevalence rates of hydronephrosis might have been underestimated. In determining the value of screening by focusing on the number of patients in whom surgically remediable hydronephrosis was identified, the authors ignore the value of definitive diagnostic information in the workup of AKI and the potential for nonsurgical approaches (eg, avoidance of anticholinergics, narcotic analgesics and other drugs, placement of Foley catheters) to ameliorate urinary tract obstruction. This was a single-center study; while the identified risk factors carry face validity, the incidence of AKI associated with urinary tract obstruction in the low-, intermediate-, and high-risk groups is likely to vary widely by institution. Finally, the authors fail to provide an estimate of the costs of *not identifying* a

case of hydronephrosis. Kidney damage may be more severe and often irreversible if urinary tract obstruction is protracted. The personal costs to a patient with postrenal AKI who fails to recover and requires maintenance dialysis are enormous; the financial costs to society of a preventable case of end-stage renal disease should be factored in the overall costs of screening estimates.

The authors' suggestion that ultrasonography be deferred in low-risk patients until other diagnostic studies prove unrevealing or where there is an inadequate response to conservative measures (eg, volume expansion) is reasonable. In our clinical practice, we have generally followed the path directed by the Licurse et al decision rule. We do not routinely perform ultrasonography on the recognition of hospital-acquired AKI. However, given the clinical implications of progressive AKI, particularly when severe enough to require dialysis, we proceed with ultrasonography in all patients—no matter their risk profile—if they have progressive AKI and if we anticipate the need for dialysis. Other studies have suggested that the proportion of patients with urinary tract obstruction as a cause of community-acquired AKI is significantly higher than for patients with hospital-acquired AKI.⁷ As such, routine ultrasonography in patients with community-acquired AKI would seem justified in the absence of more recent contradictory studies that focus on this patient population.

In conclusion, the carefully conducted study by Licurse et al helps to rationalize the diagnostic algorithm for AKI. Just as one would not advocate ordering an extensive panel of serologic studies when rapidly progressive glomerulonephritis is unlikely to be the cause of AKI, the reflex to “check a renal ultrasound” should not necessarily be exercised in all patients, at least not immediately. A more deliberate approach to diagnostic imaging in AKI is likely to conserve some resources without compromising care. These and related comparative effectiveness studies are essential to refine our approach to complex diseases, particularly when mortality, morbidity, and costs are high and therapeutic options are either of marginal efficacy or altogether absent. Acute kidney injury certainly fits that bill.

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